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LIQUID CRYSTAL DISPLAY MANUFACTURING METHOD, MANUFACTURING DEVICE AND LIQUID CRYSTAL DISPLAY

[Abstract]

PROBLEM TO BE SOLVED: To permit production at a stable tact independent of the design of a liquid crystal panel.

SOLUTION: In the process in which a liquid crystal 7 is dropped in a specified pattern and quantity in the region encircled by a sealing compound 2, the accuracy of a drip dropping the liquid crystal 7 is better than 0.4% and the distance between the position to be delivered by the liquid crystal 7 and the surface of a substrate dropping the liquid crystal 7 ranges from 10 to 100 μ m. In addition, the liquid crystal 7 is filled in a syringe 8 then pushing with a pulse

motor 5 a piston 4 for the syringe 8 in as much as a designated quantity drops the liquid crystal 7. Pinpoint accuracy of the drip is thereby ensured and the drop time can be shortened. This permits keeping production higher in displaying the quality and all the more stable in tact. Referring to the merits of the pulse motor 5, mechanically pushing a piston as opposed to a pneumatic pressurization and extrusion exerts a less influence on the viscosity of a liquid crystal and the parameters under control can be determined simply by the number of pulses which is output to a motor resulting in an increased accuracy.

【Claims】

【Claim 1】 A fabrication method for an LCD comprising the steps of:

placing a spacer member on at least one substrate of a pair of aligned electrode substrates of a liquid crystal panel, for determining a gap of the liquid crystal panel;

forming an ultraviolet curing seal member on at least one of the substrates, for bonding the substrates together and sealing liquid crystal;

drop-filling a predetermined quantity of liquid crystal in a specific pattern into an area surrounded by the seal member;

aligning and bonding the pair of substrates at a reduced pressure to form a liquid crystal panel;

shading entire areas of the liquid crystal panel except for the seal member from light and irradiating ultraviolet rays to cure the seal member; and

performing thermal-annealing at a temperature at least NI point of liquid crystal for at least one hour in order to stabilize the alignment of the liquid crystal 7 thereby removing bubbles from the liquid panel,

wherein the liquid crystal drop-filling step is performed at a precision of 0.4% or less, and a distance from a dispensing position of liquid crystal to a substrate surface onto which liquid crystal is drop-filled is in a range of 10 to 100μm.

【Claim 2】 The fabrication method for an LCD according to claim 1, wherein the liquid crystal drop-filling step comprises: filling liquid crystal into a syringe and pushing down a piston of the syringe with a pulse motor to a predetermined quantity.

【Claim 3】 The fabrication method for an LCD according to claim 2, wherein the

number and size of the syringe and the number and pitch of nozzles for dispensing liquid crystal filled into the syringe are adjustable.

【Claim 4】 The fabrication method for an LCD according to claim 3, wherein a terminal end of the nozzle is coated with Teflon®.

【Claim 5】 The A fabrication method for an LCD according to claim 1, wherein liquid crystal is drop-filled by using a liquid crystal dispenser having a piezoelectric element.

【Claim 6】 A fabrication apparatus for an LCD comprising:

a stage for fixing at least one of a pair of aligned electrode substrates via vacuum suction; and

a drop-filling unit placed above the stage, for drop-filling liquid crystal onto a substrate surface, wherein the drop-filling unit has a syringe filled with liquid crystal, a pulse motor for controlling the movement of a piston of the syringe and a nozzle connected with the syringe, for dispensing liquid crystal.

【Claim 7】 The fabrication apparatus for an LCD according to claim 6, wherein the number and size of the syringe and the number and pitch of the nozzle are adjustable.

【Claim 8】 The fabrication apparatus for an LCD according to claim 6 or 7, wherein a terminal end of the nozzle is coated with Teflon®.

【Claim 9】 A fabrication apparatus for an LCD comprising:

a stage for fixing at least one of a pair of aligned electrode substrates via vacuum suction; and

a drop-filling unit placed above the stage, for drop-filling liquid crystal onto a substrate surface, wherein the drop-filling unit is adapted to drop-fill liquid crystal by using a liquid crystal dispenser having a piezoelectric element.

【Claim 10】 An LCD provided by using a fabrication method for an LCD as described in any of preceding claims 1 to 5.

[Title of the invention]

LIQUID CRYSTAL DISPLAY MANUFACTURING METHOD, MANUFACTURING DEVICE AND LIQUID CRYSTAL DISPLAY

【Detailed Description of the Invention】

【0001】

【Field of the Invention】 The present invention relates to method and apparatus for fabricating a Liquid Crystal Display (LCD) usable as a display unit of various electronic devices and an LCD fabricated thereby.

【0002】

【Description of the Prior Art】 As a conventional fabrication method for an LCD, a vacuum injection process has been used. The vacuum injection process includes steps of: placing a spacer member on at least one of a pair of aligned electrode substrates, for determining a gap of a liquid crystal panel; forming a thermo-curing seal member on at least one of the pair of substrates, the seal member having an inlet for injecting liquid crystal and adapted to bond and fix the pair of substrates together and seal liquid crystal; aligning the two substrates and then bonding and pressing the substrates so that the seal member become a uniform gap; heat-curing the seal member and dividing and cutting the seal member except for necessary terminal parts to prepare a liquid crystal cell; placing the liquid crystal cell and liquid crystal within a vacuum chamber, decompressing the interior of the chamber, and contacting the liquid crystal cell with liquid crystal; opening the interior of the chamber to the atmospheric pressure to fill liquid crystal into the liquid crystal cell; uniformly compressing the interior of the liquid crystal-filled cell to push out unnecessary liquid crystal thereby forming a uniform cell gap; and sealing the inlet of liquid crystal with

ultraviolet curing resin.

【0003】 The vacuum injection process fills liquid crystal into the cell by using a capillary effect of liquid crystal that pushes up liquid crystal under the atmospheric pressure. In this process, injection time is varied by large quantities according to the size of the liquid crystal panel, the gap of the liquid crystal cell and the orientation and viscosity of liquid crystal, and thus production management is difficult.

【0004】

【Problems to be Solved by the Invention】 In the conventional vacuum injection process as described hereinbefore, time consumed for liquid crystal filling is unstable and thus production management is difficult. In particular, it is necessary to increase the number of liquid crystal-injecting equipments in order to realize a large-sized liquid crystal panel and a pattern design in which small-sized panels are inscribed onto a large sized substrate.

【0005】 Therefore, it is an object of the present invention to provide fabrication method and apparatus for an LCD, which can fabricate an LCD in a stable tact irrespective of the design of a liquid crystal panel by solving the foregoing problems, and an LCD fabricated thereby.

【0006】

【Means for Solving the Problem】 In order to realize the foregoing object, a fabrication method for an LCD described in claim 1 of this invention comprises steps of: placing a spacer member on at least one substrate of a pair of aligned electrode substrates of a liquid crystal panel, for determining a gap of the liquid crystal panel; forming an ultraviolet curing seal member on at least one of the substrates, for bonding the substrates together and sealing liquid crystal; drop-

filling a predetermined quantity of liquid crystal in a specific pattern into an area surrounded by the seal member; aligning and bonding the pair of substrates at a reduced pressure to form a liquid crystal panel; shading whole areas of the liquid crystal panel except for the seal member from light and irradiating ultraviolet rays to cure the seal member; and performing thermal-annealing at a temperature at least NI point of liquid crystal for at least one hour in order to stabilize the alignment of the liquid crystal 7 thereby removing bubbles from the liquid panel, wherein the liquid crystal drop-filling step is performed at a precision of 0.4% or less, and a distance from a dispensing position of liquid crystal to a substrate surface onto which liquid crystal is drop-filled is in a range of 10 to 100μm.

【0007】 As described above, since the method comprises the step of drop-filling a predetermined quantity of liquid crystal in a specific pattern into an area surrounded by the seal member, wherein the liquid crystal drop-filling step is performed at a precision of 0.4% or less, and a distance from a dispensing position of liquid crystal to a substrate surface onto which liquid crystal is drop-filled is in a range of 10 to 100μm, it is possible to raise the precision of drop-filling quantity as well as promote reduction is drop-filling time, thereby improving display quality as well as enabling production at a stable tact. Furthermore, in the case of drop-filling, since there is a risk that alignment scratches will take place by contacting a nozzle for dispensing liquid crystal to the aligned substrate, in order to avoid this risk, the distance between the nozzle and the substrate can be set by at least 10μm to prevent any alignment scratches. Also, by setting the distance between the nozzle and the substrate by 100μm or less, it is possible to attribute to reduction in drop-filling time. Furthermore, at a distance of 100μm or more from the nozzle to the substrate, there is a low probability that liquid crystal

contact the substrate. Moreover, 0.4% as a basis of the degree of drop-filling quantity of liquid crystal is a precision in which setting the gap precision of the panel at ±0.1㎛ or less is needed. However, there are no strict requirements for piezoelectric elements.

【0008】 This fabrication method can enable the stabilization of tact, and thus can provide a fabrication method for an LCD having high gap precision and yield.

【0009】 The fabrication method for an LCD described in claim 2 has following features in addition to those of claim 1, wherein the liquid crystal drop-filling step comprises: filling liquid crystal into a syringe and pushing down a piston of the syringe with a pulse motor to a predetermined quantity. Like this, since liquid crystal is filled into the syringe and the piston of the syringe is pressed down with the pulse motor to drop-fill liquid crystal, it is possible to promote improvement in the precision of drop-filling quantity. Unlike compressed dispensing by air, the pulse motor has a merit in that the piston is mechanically pressed down causing little influence to the viscosity of liquid crystal so that parameters to be controlled can be determined only by the number of pulses applied to the motor. Then, motor can rotate by this pulse number and thus press down the piston thereby drop-filling liquid crystal onto the substrate as much as changed volume fraction. Furthermore, it is also possible to press down a plurality of pistons with one pulse motor even though the number of the syringe is increased.

【0010】 The fabrication method for an LCD described in claim 3 has following features in addition to those of claim 2, wherein the number and size of the syringe and the number and pitch of nozzles for dispensing liquid crystal filled into the syringe are adjustable. Like this, since the number and size of the syringe and the number and pitch of nozzles for dispensing liquid crystal filled

into the syringe are adjustable, even though various types of panels are designed and arranged in one substrate, it is possible to cope with this arrangement by properly changing the inside diameter of the syringe and adjusting the position of the nozzle.

【0011】 The fabrication method for an LCD described in claim 4 has following features in addition to those of claim 3, wherein a terminal end of the nozzle is coated with Teflon®. Like this, since a terminal end of the nozzle is coated with Teflon resin, even though the nozzle touches the substrate, no alignment scratches and the like take place.

【0012】 The fabrication method for an LCD described in claim 5 has following features in addition to those of claim 1, liquid crystal is drop-filled by using a liquid crystal dispenser having a piezoelectric element. Like this, the same effect can be achieved even by drop-filling liquid crystal with the liquid crystal dispenser having the piezoelectric element.

【0013】 A fabrication apparatus for an LCD as described in claim 6 comprises: a stage for fixing at least one of a pair of aligned electrode substrates via vacuum suction; and a drop-filling unit placed above the stage, for drop-filling liquid crystal onto a substrate surface, wherein the drop-filling unit has a syringe filled with liquid crystal, a pulse motor for controlling the movement of a piston of the syringe and a nozzle connected with the syringe, for dispensing liquid crystal.

【0014】 Like this, since the drop-filling unit has the syringe filled with liquid crystal, the pulse motor for controlling the movement of the piston of the syringe and the nozzle connected with the syringe, for dispensing liquid crystal, it is possible to promote improvement in precision by mechanically pressing the piston of the pulse motor in order to control the quantity of drop-filling.

【0015】 Unlike compressed dispensing by air, the pulse motor has a merit in that the piston is mechanically pressed down causing little influence to the viscosity of liquid crystal so that parameters to be controlled can be determined only by the number of pulses applied to the motor. Then, motor can rotate by this pulse number and thus press down the piston thereby drop-filling liquid crystal onto the substrate as much as changed volume fraction. Furthermore, it is also possible to press down a plurality of pistons with one pulse motor even though the number of the syringe is increased.

【0016】 In addition, since the quantity of drop-filling changes in proportion with the inside diameter of the syringe at a fixed rotation rate, in order to control drop-filling quantity in a minute panel, the inside diameter of the syringe and the rotation rate (pulse number) of the pulse motor can be controlled with a high precision.

【0017】 The fabrication apparatus for an LCD described in claim 7 has following features in addition those of claim 6, wherein the number and size of the syringe and the number and pitch of the nozzle are adjustable. Like this, since the number and size of the syringe and the number and pitch of the nozzle can be adjusted, even though various types of panels are designed and arranged in one substrate, it is possible to cope with this arrangement by properly changing the inside diameter of the syringe and adjusting the position of the nozzle.

【0018】 The fabrication apparatus for an LCD described in claim 8 has following features in addition to those of claim 6 or 7, wherein a terminal end of the nozzle is coated with Teflon®. Like this, since a terminal end of the nozzle is coated with Teflon resin, even though the nozzle touches the substrate, alignment scratches and the like rarely take place.

【0019】 A fabrication apparatus for an LCD as described in claim 9 comprises: a stage for fixing at least one of a pair of aligned electrode substrates via vacuum suction; and a drop-filling unit placed above the stage, for drop-filling liquid crystal onto a substrate surface, wherein the drop-filling unit is adapted to drop-fill liquid crystal by using a liquid crystal dispenser having a piezoelectric element. Like this, the same effect can be achieved even though the fabrication apparatus has a function of drop-filling liquid crystal with the liquid crystal dispenser having the piezoelectric element.

【0020】 An LCD as described in claim 10 is provided by using a fabrication method for an LCD as described in any of preceding claims 1 to 5. Like this, by providing an LCD by using the fabrication method for an LCD as described in any of preceding claims 1 to 5, it is possible to provide an LCD having an excellent display quality without ring-shaped cohesion drop-filling marks in a display condition.

【0021】

【Embodiment of the Invention】 Embodiments of the present invention will be described in conjunction with FIGS. 1 to 5 (R>5). FIG. 1 is a schematic view illustrating a liquid crystal drop filling apparatus according to an embodiment of the invention.

【0022】 As shown in FIG. 1, an aligned electrode substrate 3 provided with a seal member 2 is loaded on a stage 1, which is movable in vertical and lateral directions. The electrode substrate 3 is fixed to the stage 1 via vacuum suction. A drop filling unit is placed above the stage 1. The drop filling unit includes syringes 8 filled with liquid crystal 7, a pulse motor 5 for controlling the movement of pistons 4, a bar 6 designed to transfer the rotation of the pulse

motor 5 to the pistons 4, a syringe holder 9 for fixing the syringes 8, nozzles 10 communicating with the syringes 8 to dispense liquid crystal 7, Teflon tubes 11 for connecting the nozzles 10 to the syringes 8 and a drop filling head 12 in which the nozzles 10 are placed. Besides, in the drop filling unit, the number and size of the syringes 8 and the pitch of the nozzles 10 can be adjusted. Terminal ends of the nozzles 10 are coated with Teflon resin.

【0023】A fabrication method for actually filling liquid crystal drops and fabricating an LCD will now be described. That is, the fabrication method for an LCD includes steps of: placing a spacer member on at least one substrate 3 of the pair of aligned electrode substrates 3 of a liquid crystal panel, for determining a gap of the liquid crystal panel; forming the (meta-) acrylate-based or epoxy-based ultraviolet curing seal member 2 on at least one of the substrates 3, for bonding the substrates 3 together and sealing liquid crystal; drop-filling a predetermined quantity of liquid crystal in a specific pattern into an area surrounded by the seal member 2; aligning and bonding the pair of substrates 3 at a reduced pressure of 0.8 torr or less to form the liquid crystal panel; shading whole areas of the liquid crystal panel except for the seal member 2 from light and exposing ultraviolet rays to cure the seal member 2; performing thermal-annealing at a temperature at least NI point of liquid crystal 7 for at least one hour in order to stabilize the alignment of the liquid crystal 7 thereby removing bubbles from the liquid panel.

【0024】Besides, in the drop-filling procedure of liquid crystal, liquid crystal 7 is filled into the syringes 8 and the pistons 4 of the syringes 8 are pressed by the pulse motor 5 to drop-fill a certain quantity of liquid crystal 7. The precision of drop filling liquid crystal 7 is 0.4% or less, the time of drop filling liquid crystal 7 is 3 minutes or less, and the distance from the nozzle terminal ends as liquid

crystal 7 dispensing positions to a substrate surface onto which liquid crystal 7 is dispensed is on the order of 10 to 100μm. In this case, the stage 1 is displaced toward the nozzles 10 so that the distance between the substrate 3 and the nozzles 10 becomes within 10 to 100μm. Then, the pulse motor 5 is rotated at a predetermined pulse number to push down the pistons 4. Then, liquid crystal 7 is drop-filled onto the substrate 3 through the nozzles 10 from the syringes 8 by the quantity of changed volume fraction. Then, the stage 1 moves downward and then horizontally to a next point.

【0025】 In this case, the pulse motor presses the pistons by the relationship of 10μm per 1 pulse. FIG. 2 is a graph of a relationship of drop-filling quantities when the pulse motor is rotated by 10 pulses, measured by varying the inside diameter of a syringe by 0.1, 0.5, 1 and 5mm.

【0026】 As can be seen from this graph, it can be understood that the quantity of drop filling is varied in proportion to the inside diameter size of the syringe at a fixed rotation rate. Therefore, in order to control the quantity of drop filling into the minute panel, it is required to be able to properly control the inside diameter of the syringe and the degree of rotation (pulse number) of the pulse motor.

【0027】 A 13 inch XGA type TFT panel was actually fabricated for trial according to drop filling. The quantity of liquid crystal fed into this panel is length 24mm X width 310mm X gap 5μm = 372 ml. Pattern 2 shown in FIGS. 3 and 4 was performed as a drop-filling pattern. In this case, FIG. 3 is a drop-filling pattern A, and FIG. 4 is a drop-filling pattern B. In the drop-filling pattern A, the quantity of drop filling at 1 point becomes 372ml ÷ (24 points × 60 points) = 0.258ml. In the drop-filling pattern B, the quantity of drop filling at 1 point becomes 372ml ÷ (46 points × 60 points) = 0.135ml. The drop-filling pattern A has a longitudinal pitch of

9mm and a lateral pitch of 4.65mm, in which a drop-filling point at a corner is distanced longitudinally 17.8mm and laterally 16.5mm from the seal member 2. The drop-filling pattern B has a longitudinal pitch of 5.0mm and a lateral pitch of 5.0mm, in which a drop-filling point at a corner is distanced longitudinally 5.0mm and laterally 5.0mm from the seal member 2.

【0028】Thus, in the drop-filling pattern A, when 33 pulses are applied to the pulse motor by using φ 1.0mm syringes, the quantity of drop-filling becomes 33 pulses × 0.00785ml × 24 points × 60 points = 373.032ml, which is within the range of 372ml ± 0.4%. Then, in the drop-filling pattern B, the quantity of drop-filling becomes (17 pulses × 0.00785ml) × (46 points × 60 points) + (17 pulses × 0.0019625ml) × (2 points × 60 points) = 372.3ml, which is also within the range of 372ml ± 0.4%. In the drop-filling pattern B, drop filling is performed on rows in upper and lower ends of the drawing, first with a φ 1.0mm syringe and then with φ 0.5mm syringe. This makes it possible to adjust the quantity of drop filling with a high precision. Drop-filling patterns and display qualities are represented in Table 1 below:

【0029】

【Table 1】

Poor display	Drop filling pattern	
	A	B
Stain in surface	o	o
Bubble remained in surface	X	o

【0030】From this result, it is seen that bubbles cannot be removed from a panel corner in case of the drop-filling pattern A since the drop-filling points have a long

distance from the seal member. Furthermore, the stain in surface did not occur since the pitch of drop-filling points became 10mm.

【0031】 This drop filling of liquid crystal was performed by connecting two nozzles to one syringe, in which 12 syringes were arranged in parallel in case of the drop-filling pattern A and 23 syringes were arranged in parallel in case of the drop-filling pattern B. Furthermore, in the drop-filling pattern 2, as second drop filling, one syringe was separately prepared and connected equally to two nozzles. In the drop-filling pattern A, drop filling was terminated for every 1 minute with 1 second X 60 pints since 1 second was consumed under 1 ringer. The drop-filling pattern B was terminated in 2 minutes. If drop-filling time exceeds 3 minutes, a ring-shaped stain took place at a drop-fill point in case of voltage application and display quality is degraded.

【0032】 Furthermore, as shown in Fig. 5, even if panels 20 and 21 (7.8 types and 13 types) having a plurality of patterns are designed in one sheet of substrate 3, by achieving the design matching between the drop-filling pitch and the panels 20 and 21, the plurality of panels can be produced simultaneously with one apparatus through adjustment in the size and number of syringes. Then, it is possible to promote reduction in fabrication loss.

【0033】 In addition, the drop-filling unit may have a function of drop-filling liquid crystal by using a liquid crystal dispenser having a piezoelectric element.

【0034】

【Effects of the Invention】 As described above, according to the fabrication method described in claim 1, since the method comprises the step of drop-filling a predetermined quantity of liquid crystal in a specific pattern into an area surrounded by the seal member, wherein the liquid crystal drop-filling step is

performed at a precision of 0.4% or less, and a distance from a dispensing position of liquid crystal to a substrate surface onto which liquid crystal is drop-filled is in a range of 10 to 100μm, it is possible to raise the precision of drop-filling quantity as well as promote reduction is drop-filling time, thereby improving display quality as well as enabling production at a stable tact. Furthermore, in the case of drop-filling, since there is a risk that alignment scratches will take place by contacting a nozzle for dispensing liquid crystal to the aligned substrate, in order to avoid this risk, the distance between the nozzle and the substrate can be set by at least 10μm to prevent any alignment scratches. Also, by setting the distance between the nozzle and the substrate by 100μm or less, it is possible to attribute to reduction in drop-filling time. Since the LCD fabricated like this has high display quality, it is possible to arrange a plurality of panels on one substrate without any production loss, produce at a stable tact and facilitate production management.

【0035】 According to the fabrication method for an LCD described in claim 2, since liquid crystal is drop-filled into a syringe and pushing down a piston of the syringe with a pulse motor to a predetermined quantity, it is possible to promote improvement in the precision of drop-filling quantity. Unlike compressed dispensing by air, the pulse motor has a merit in that the piston is mechanically pressed down causing little influence to the viscosity of liquid crystal so that parameters to be controlled can be determined only by the number of pulses applied to the motor. Then, motor can rotate by this pulse number and thus press down the piston thereby drop-filling liquid crystal onto the substrate as much as changed volume fraction. Furthermore, it is also possible to press down a plurality of pistons with one pulse motor even though the number of the syringe

is increased.

【0036】 According to claim 3, since the number and size of the syringe and the number and pitch of nozzles for dispensing liquid crystal filled into the syringe are adjustable, even though various types of panels are designed and arranged in one substrate, it is possible to cope with this arrangement by properly changing the inside diameter of the syringe and adjusting the position of the nozzle.

【0037】 According to claim 4, a terminal end of the nozzle is coated with Teflon resin, even though the nozzle touches the substrate, no alignment scratches and the like take place.

【0038】 According to claim 5, the same effect can be achieved even by drop-filling liquid crystal with the liquid crystal dispenser having the piezoelectric element.

【0039】 According to the fabrication apparatus for an LCD as described in claim 6, since the drop-filling unit has the syringe filled with liquid crystal, the pulse motor for controlling the movement of the piston of the syringe and the nozzle connected with the syringe, for dispensing liquid crystal, it is possible to promote improvement in precision by mechanically pressing the piston of the pulse motor in order to control the quantity of drop-filling.

【0040】 Unlike compressed dispensing by air, the pulse motor has a merit in that the piston is mechanically pressed down causing little influence to the viscosity of liquid crystal so that parameters to be controlled can be determined only by the number of pulses applied to the motor. Then, motor can rotate by this pulse number and thus press down the piston thereby drop-filling liquid crystal onto the substrate as much as changed volume fraction. Furthermore, it is also possible to press down a plurality of pistons with one pulse motor even though

the number of the syringe is increased.

【0041】 In addition, since the quantity of drop-filling changes in proportion with the inside diameter of the syringe at a fixed rotation rate, in order to control drop-filling quantity in a minute panel, the inside diameter of the syringe and the rotation rate (pulse number) of the pulse motor can be controlled with a high precision.

【0042】 According to claim 7, since the number and size of the syringe and the number and pitch of the nozzle can be adjusted, even though various types of panels are designed and arranged in one substrate, it is possible to cope with this arrangement by properly changing the inside diameter of the syringe and adjusting the position of the nozzle.

【0043】 According to claim 8, since a terminal end of the nozzle is coated with Teflon resin, even though the nozzle touches the substrate, alignment scratches and the like rarely take place.

【0044】 According to the fabrication apparatus for an LCD as described in claim 9 of this invention, the same effect can be achieved even though the fabrication apparatus has a function of drop-filling liquid crystal with the liquid crystal dispenser having the piezoelectric element.

【0045】 According to the LCD as described in claim 10 of this invention, by providing an LCD by using the fabrication method for an LCD as described in any of preceding claims 1 to 5, it is possible to provide an LCD having an excellent display quality without ring-shaped cohesion drop-filling marks in a display condition.

【Description of Drawings】

FIG. 1 is A schematic view illustrating a liquid crystal drop filling apparatus

according to an embodiment of the invention;

FIG. 2A is a graph illustrating a relationship of the inside diameter of a drop-filling syringe with drop-filling quantities according to an embodiment of the invention;

FIG. 3A is a view illustrating a drop-filling pattern A according to an embodiment of the invention;

FIG. 4 is a view illustrating a drop-filling pattern B according to an embodiment of the invention; and

FIG. 5 is a schematic view illustrating a substrate in which a plurality of panels are arranged thereon according to an embodiment of the invention.

【Explanation on Reference Numerals】

1 stage

2 seal member

3 aligned electrode plate

4 piston

5 pulse motor

6 bar

7 liquid crystal

8 syringe

9 syringe holder

10 nozzle

11 teflon tube